

I claim:

1. A method for performing real-time computer garbage collection, for use with a plurality of data objects and with one or more mutator programs, each one of said mutators having a corresponding thread and each one of said mutator threads having a corresponding thread state, said method comprising the following steps:

commencing a new garbage collection cycle;  
temporarily restricting execution of said mutators;  
for each one of said mutators, processing the corresponding thread state;  
permitting each one of said mutators to resume unrestricted execution, as soon as said mutator's own corresponding thread state has been processed;  
completing the garbage collection cycle by identifying each one of said objects that is currently accessible to at least one of said mutators.

2. The method of claim 1, wherein said step of commencing a garbage collection cycle further includes the step of flipping one or more of said objects, from first label representative of accessible status to a second label representative of undetermined status.

3. The method of claim 1, wherein said step of commencing a garbage collection cycle further includes the step of saving a list of said mutator threads.

4. The method of claim 1, wherein said step of temporarily restricting the execution of said mutators includes a first step of restricting said mutators from creating any new data objects, and a second step of temporarily suspending execution of said mutators.

5. The method of claim 1, wherein said step of completing the garbage collection cycle further includes the step of tracing one or more pointers stored in each of said mutator thread states.

6. The method of claim 1, wherein said step of completing the garbage collection cycle further includes the step of tracing one or more pointers stored in said objects, for each one of said objects that is in turn pointed to by at least one pointer stored in at least one of said mutator thread states.

7. The method of claim 1, wherein said step of completing the garbage collection cycle is performed without copying said objects.

8. The method of claim 1, wherein said step of completing the garbage collection cycle further includes the step of executing said mutators subject to a write barrier, but wherein said write barrier is not applied to modification of said thread states.

9. An apparatus for performing real-time computer garbage collection, for use with a plurality of data objects and with one or more mutator programs, each one of said mutators having a corresponding thread and each one of said mutator threads having a corresponding thread state, said apparatus comprising:

a garbage collector for processing the corresponding thread states of said mutators at the beginning of a garbage collection cycle, and for identifying each one of said data objects that is accessible to at least one of said mutators during said cycle;

one or more processors for executing said garbage collector and said mutators; and

15 scheduling means coupled to said processors for  
scheduling execution of said garbage collector and said  
mutators on said processors, said scheduling means being  
operative to temporarily restrict execution of said  
mutators during said garbage collection cycle, and to  
20 permit each one of said mutators to resume unrestricted  
execution as soon as said mutator's own corresponding  
thread state has been processed.

5 10. The apparatus of claim 9, wherein said garbage  
collector further includes means for flipping said one or  
more objects from a first label representative of  
accessible status to a second label representative of  
undetermined status.

11. The apparatus of claim 9, wherein said garbage  
collector further includes means for saving a list of  
said mutator threads.

12. The apparatus of claim 9, wherein said garbage  
collector includes means for tracing one or more pointers  
stored in each of said mutator thread states.

5 13. The apparatus of claim 9, wherein said garbage  
collector includes means for tracing one or more pointers  
stored in said data objects, for each one of said objects  
that is in turn pointed to by at least one pointer stored  
in at least one of said mutator thread states.

14. The apparatus of claim 9, wherein said garbage  
collector does not copy said data objects.

15. The apparatus of claim 9, wherein said one or more  
processors are implemented with stock hardware.

16. The apparatus of claim 9, wherein said scheduling means is operative to temporarily restrict said mutators from creating any new data objects, and is further operative to suspend execution of said mutators.

17. The apparatus of claim 9, further including means for executing said mutators subject to a write barrier, but wherein said write barrier is not applied to modification of said mutator thread states.

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